

THE NATIONAL ACADEMIES OF SCIENCES  
Workshop on Landscape Approaches and Multi-Resource  
Analysis for Sustainable Natural Resource Management

# Methods for Evaluating Scenarios: Reconciling Quantities and Values

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# Existing Frameworks

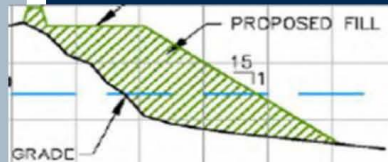
- Frameworks exist to (a) address multi-resource tradeoffs and (b) link biophysical outcomes to values
  - Economic valuation is the most established and applied.
  - Enables internally consistent and generalizable results.
- Applicable methods depend on results that are needed and the context for analysis.
  - Type of information and degree of precision required
  - Time, resources and capacity available
- Requires identification and measurement of outcomes consistent with the measurement of social value.
- Cannot simply build economic values on top of standard biophysical assessments.

# Economic Valuation

- Economic valuation is designed to enable comparison of values across different outcomes.
  - Directly linked to social well-being in an internally consistent, quantitative and formal model
  - Addresses the apples vs. oranges problem; enables tradeoffs to be evaluated in consistent units.
  - Measures values realized by the public; can account for heterogeneity.
  - Market values and ecosystem service valuation are fully-embedded subsets of economic valuation.
  - Valuation does not “determine the outcome.”

# Values Across Scenarios and Effects— Delaware Bay Beach Management

## Enhanced Retreat - Defined



Initially remove structure to allow a beach/dune width equal to the recommended beach nourishment templates for each community.

As additional erosion/shoreline migration occurs, additional structures are removed to maintain this beach width



Johnson, Mirmiran and Thompson Inc. (2012). Shoreline and housing loss projections, Delaware Department of Natural Resources and Environmental Control scenarios for Delaware Bay beaches. Dover, DE: Delaware Department of Natural Resources and Environmental Control.

# Values Across Scenarios and Effects— Delaware Bay Beach Management

<b>Scenario</b>	<b>(A) Sand, Fill and Demolition (PV, \$mill)</b>	<b>(B) Housing Acquisition Payments (paid by State)  (PV, \$mill)</b>	<b>(C) Housing Acquisition Payments (received by property owners)  (PV, \$mill)</b>	<b>(D) Recreation (PV, \$mill)</b>	<b>(E) Housing Services  (PV, \$mill)</b>	<b>(F) Reduction in Add'l Flood and Erosion Damages (PV, \$mill)</b>	<b>(G) Net Benefits  (PV, \$mill; sum of A through F)</b>
<b>Nourish- ment</b>	<b>-\$61.1</b>	<b>-\$0</b>	<b>\$0</b>	<b>\$16.1</b>	<b>\$18.2</b>	<b>\$2.7</b>	<b>-\$24.1</b>
<b>Basic Retreat</b>	<b>-\$0.5</b>	<b>-\$61.3</b>	<b>\$61.3</b>	<b>\$10.8</b>	<b>-\$43.1</b>	<b>\$3.0</b>	<b>-\$29.8</b>
<b>Enhanced Retreat</b>	<b>-\$4.5</b>	<b>-\$149.1</b>	<b>\$149.1</b>	<b>\$10.8</b>	<b>-\$130.9</b>	<b>\$10.6</b>	<b>-\$114.0</b>

# Valuation and Tradeoffs – Perceived versus Actual Challenges

- It is standard practice to compare economic values provided by diverse market and non-market resources across landscapes
  - substitution (tradeoffs) must be permissible
  - empirical difficulty (biophysical and economic) varies and can be considerable; off-the-shelf tools are rarely accurate.
- Perceived versus actual challenges
  - Objections to the idea of monetization and the degree to which it is applicable. Fear of economic imperialism.
  - Misunderstanding and misapplication of methods, particularly with mapping and decision-support tools
  - Difficulty of modeling and quantifying relevant aspects of biophysical change and coupling to economic models.
  - External or arbitrary constraints imposed on what is to be measured and how

# External or Arbitrary Constraints

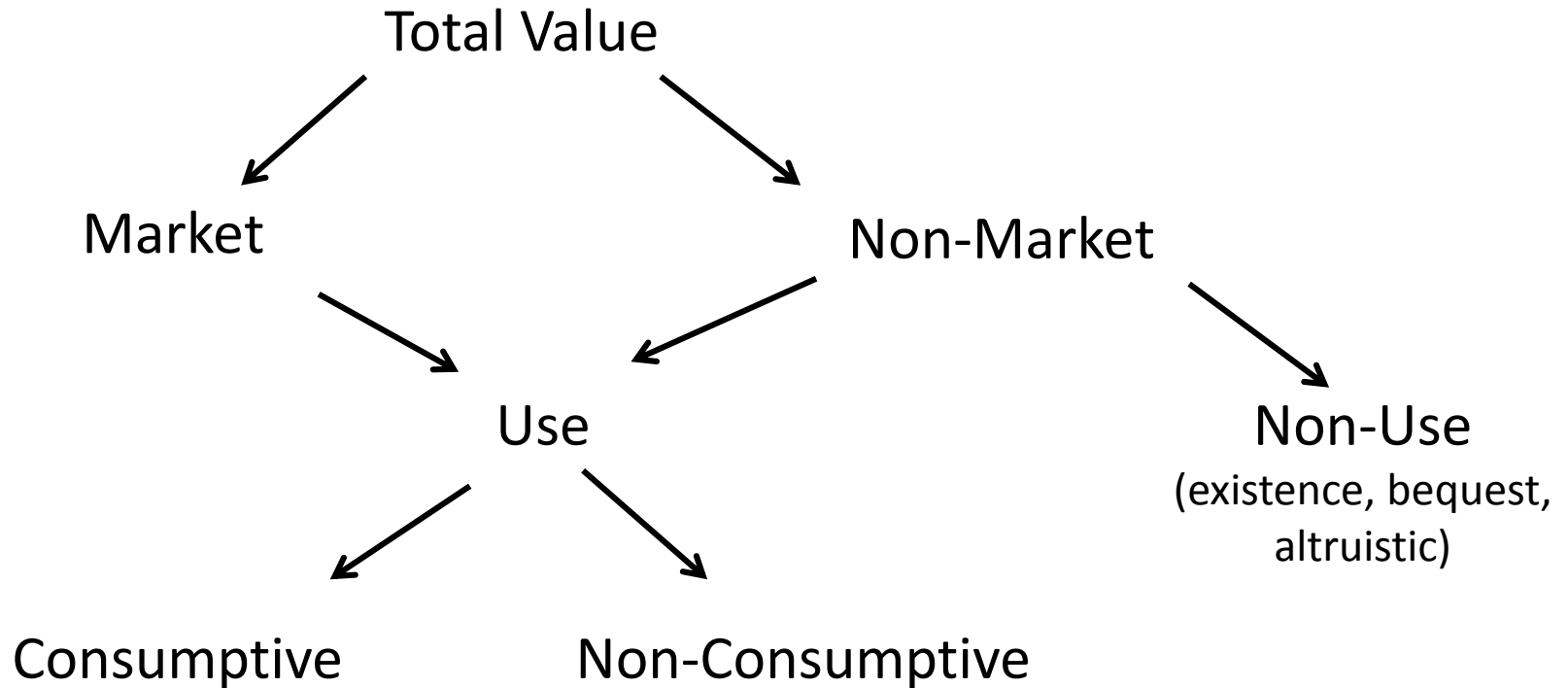
- External or arbitrary constraints are often imposed on analysis of values.
  - Attempts to map values across the landscape and assign a value to every pixel.
  - Arbitrary distinctions between value types (e.g., ecosystem service values versus other values).
  - Values that agencies “may” or “may not” consider.
  - Distinctions between favored and unfavored valuation methods (distinct from the scientific literature).
  - Push for one-size-fits-all decision-support tools.
- These constraints limit multi-resource analysis and can produce misleading results.

# What are the (True) Linkages?

- Dispense with arbitrary constraints to focus on underlying linkages between actions, biophysical changes, and human values.
  - Identify causal chains linking actions to values.
  - This enables major areas of human benefit to be identified and linked to biophysical changes
  - Afterwards, the agency can decide whether it wants to (or can) quantify all of these.
  - Typically, only a subset of primary values can be measured empirically.



# How Economists Categorize Value

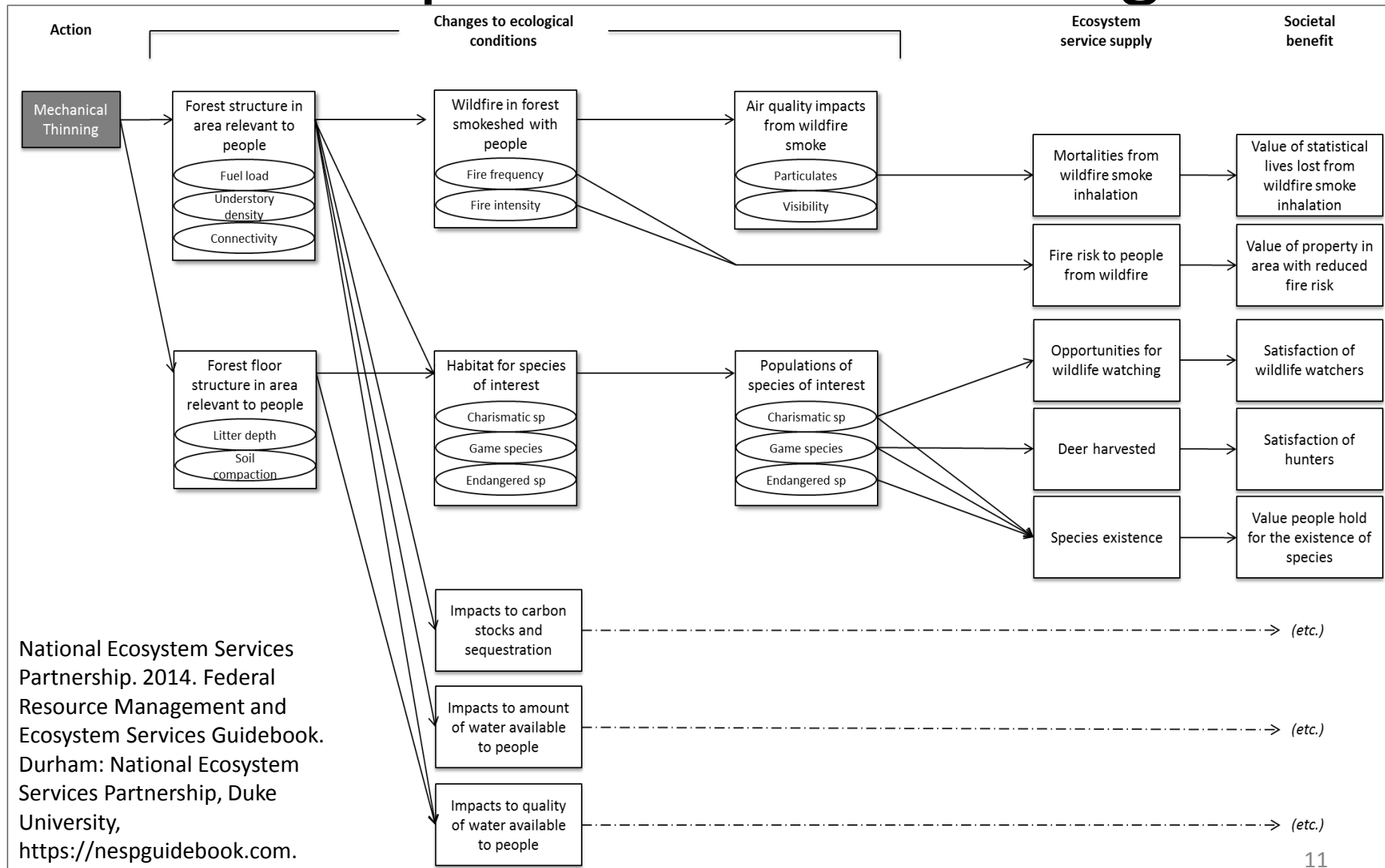


Note – Ecosystem service values can occur in any of these categories.

# Developing Causal Chains

- Determining what to count as a basis for valuation (developing causal chains or means-ends diagrams)
  - Identify the beneficiaries by fiat (political jurisdiction) or by analysis of where values exist (economic jurisdiction).
  - Link actions to biophysical change (accounting for human behavioral changes as necessary)
  - Identify benefit relevant indicators along the chain (biophysical links in the chain that are directly associated with values, accounting for potential access and demand).
  - Link biophysical changes to primary changes in social welfare (valuation)
  - Scenario analysis

# Example—Forest Thinning

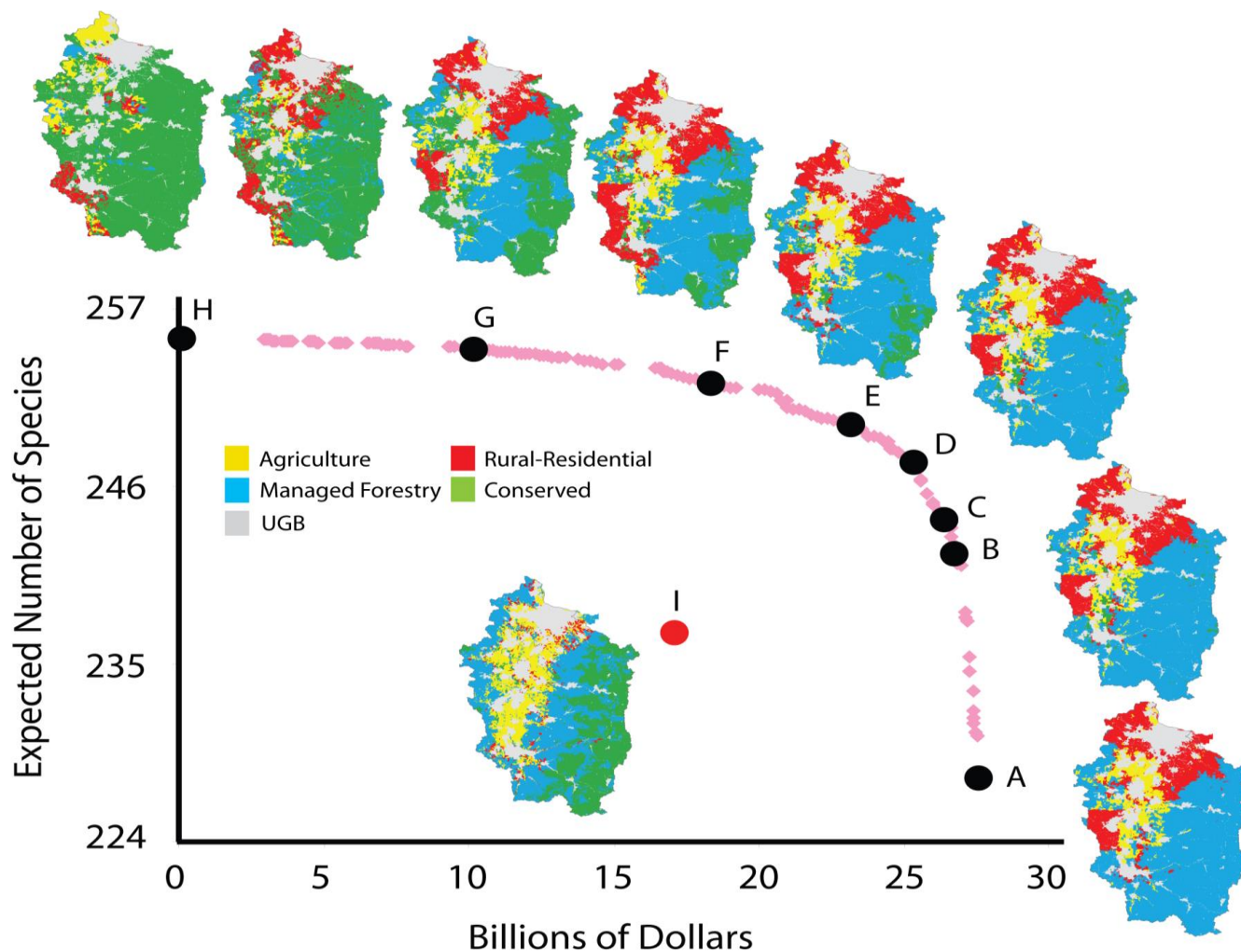


National Ecosystem Services Partnership. 2014. Federal Resource Management and Ecosystem Services Guidebook. Durham: National Ecosystem Services Partnership, Duke University, <https://nespguidebook.com>.

# What will be measured and how?

- Options for empirical analysis include:
  - None or purely qualitative/descriptive
    - little relevance for evaluating tradeoffs or value; very limited for multi-resource analysis
  - Quantify benefit relevant indicators
    - measures “valued things” but not values; ability to inform tradeoffs or rank scenarios limited
  - Quantify values
    - Enables multi-resource tradeoffs to be evaluated and scenarios to be ranked in terms of social benefits realized by different beneficiary groups

# Tradeoffs and Values



Source: S. Polasky, et al. "Where to Put Things? Spatial Land Management to Sustain Biodiversity and Economic Returns," *Biological Conservation* 141(6) (2008): 1505–1524.

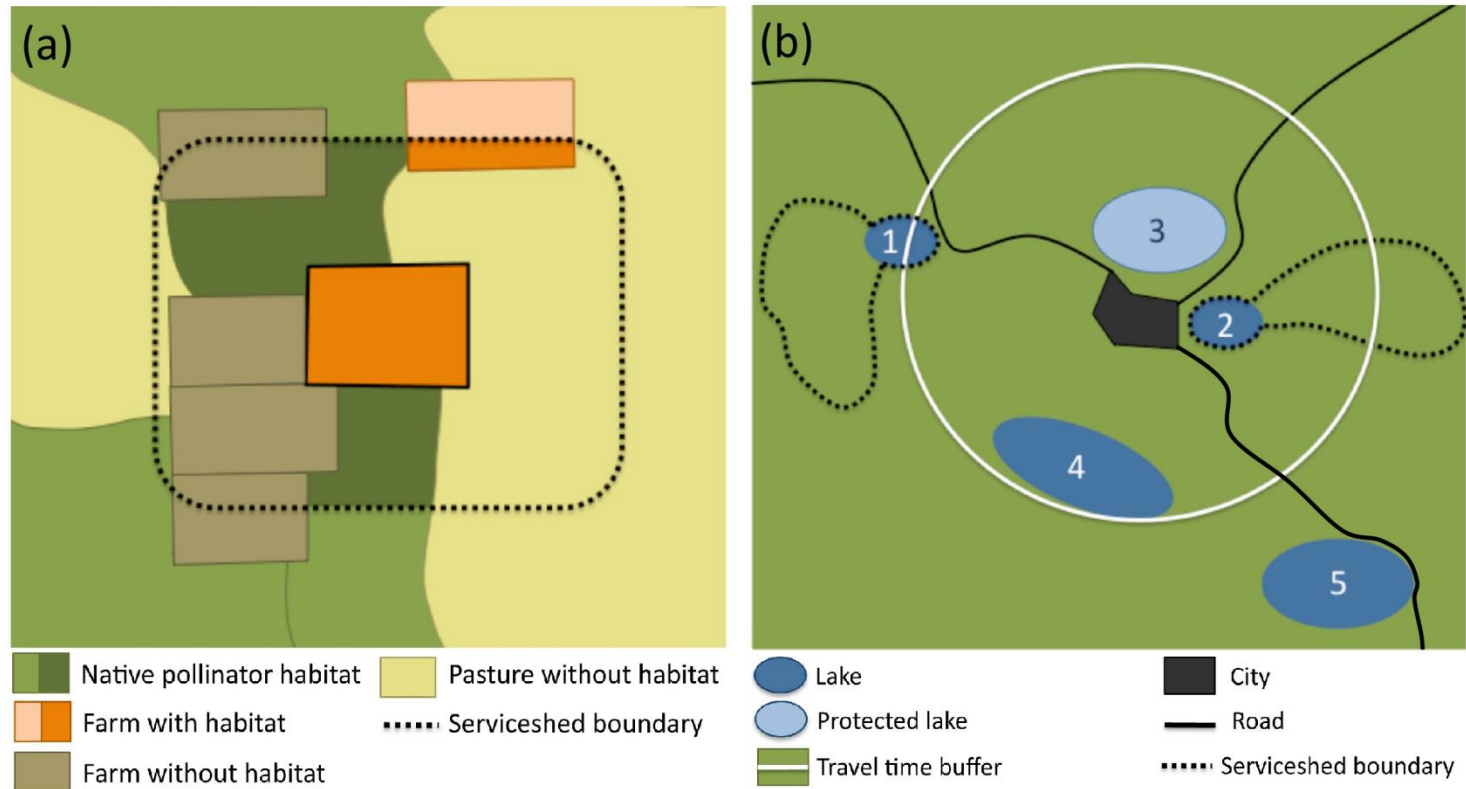
# Measuring Economic Value

- Market Values (consumer and producer; use values)
- Revealed Preference Methods (use values)
  - Hedonic Methods (e.g., property value)
  - Defensive Behavior Methods
  - Recreation Demand Models
  - Factor Input Methods
  - Replacement & damage costs (but only valid in very rare circumstances)
- Stated Preference Methods (use and nonuse values)
  - Contingent Valuation
  - Discrete Choice Experiments (DCEs)
- Benefit Transfer

# Misuses

- Misapplication of economic tools:
  - Estimation of values for totals rather than marginals.
  - Using invalid or ad hoc methods to measure value.
- Invalid scaling of value over areas, quantities or qualities.
  - Assuming values linearly related to biophysical quantities, or biophysical quantities scaled by area or human population.
- Attempts to place a value for every resource on every pixel of a resource “value map.”
- Misunderstanding of uses, advantages and disadvantages of valuation methods.
- Decision-support tools that do not recognize the context specific nature of values.

# Populations, Accessibility and Values ("Servicesheds")



Olander, L., R.J. Johnston, H. Tallis, J. Kagan, L. Maguire, J. Boyd, and S. Polasky. 2015.  
Best Practices for Integrating Ecosystem Services into Federal Decision Making.  
Working Paper.



# Summary

- Established tools exist to measure and compare values provided by multiple resources.
- Concepts are straightforward and established; empirical applications can be challenging. Data are often limited.
- Requires capacity in both natural and social science.
- External constraints placed on the analysis often hinder valid and comprehensive evaluation of tradeoffs.
- Identification of benefit relevant indicators is critical.
- Values are context specific; cannot be calculated from biophysical, spatial or demographic measures alone.
- Few values are amenable to simple mapping or universal decision support tools. Landscape analysis  $\neq$  Value map.